

Sustainable financing of HIV/AIDS and the economic impact in Africa: Evidence from a dynamic life cycle horizon of Uganda

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Financing HIV/AIDS responses in Africa: impact evidence from Uganda

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ABSTRACT Although HIV/AIDS has been tamed medically into a chronic disease through advances in treatment drugs, the full economic costs of keeping people on treatment and implementing prevention measures are still not fully quantified and are still unfolding. This paper assesses the long-term economic impact of domestic and external sources of financing HIV responses using a dynamic computable general equilibrium model. Taking Uganda as a case study for analysis, our study shows that increasing government HIV funding facilitates higher GDP growth and lower government debt relative to the baseline. Earmarked taxes and foreign-aid are potential sources of fiscal space for HIV.

Keywords: Economic Development; HIV/AIDS; HIV financing; Computable General Equilibrium; Sub-Saharan Africa; Uganda

JEL classification: D580, I130, O11

1 Introduction

Despite remaining a major killer in Africa, the HIV pandemic has been tamed medically into a chronic disease through advances in treatment drugs – antiretroviral therapies (ARTs). However, the full economic costs, over a lifecycle horizon, of keeping people on treatment and implementing

prevention measures, are still not fully quantified and are still unfolding. Indeed, the economic effects of the HIV/AIDS disease, and also the economic effects of various interventions need to be better understood. Sub-Saharan Africa (SSA) disproportionately bears the burden of HIV/AIDS compared to the rest of the world. Over 70% of the people living with HIV (PLHIV) are resident in SSA, of which 82% are adults (UNAIDS, 2014). The commitment by governments to provide HIV treatment to those who need it constitutes a long-term financial liability which can be conceptualised as a debt liability (Collier, Sterck, & Manning, 2015; Haacker, 2011). On the other hand, it is also evident that Development Assistance for Health (DAH) has significantly shifted away from HIV/AIDS and its sustainability is not certain (IHME, 2014a).

Sustainability of funding health systems for HIV is a longer term objective that requires planning in the context of a wider health sector environment, involving financial and non-financial aspects. Major donors who provide DAH have approached the funding sustainability issue in different ways. Some donors, such as GAVI, agree that financial sustainability is a shared concern and shared responsibility of both domestic governments and their development partners. To this end financial sustainability refers to the government's fiscal capacity to sustain or increase current spending, tax and other policies to ensure continuity of activities in the long run in addition to external resources. On the other hand, donors such as PEPFAR emphasise domestic governments growing their capacity to finance their health systems with indigenous resources rather than external resources. New challenges posed by the AIDS epidemic call for a strategic shift in global health that emphasizes sustainability of development assistance (The Lancet Editorial, 2012). On the domestic front, McIntyre and Meheus argue that government revenue generation (tax and non-tax) is a strong determinant of government spending levels for health and other social services (McIntyre & Meheus, 2014). The views on sustainability of a funding model for HIV need to be better understood in the context of the whole economy. We fill this gap in this paper by demonstrating how domestic and foreign funding sources could impact the wider economy.

HIV/AIDS impacts the economy directly and indirectly through labour quantity and quality, total factor productivity, and the quantity of savings and investment. At the micro level, the household experiences increased costs of healthcare expenditure and faces indirect costs of reduced earnings and

income when the productive household members are infected. At the meso level, sectors that are labour intensive are faced with lower labour productivity and the increased demand for HIV related healthcare implies that the health sector incurs higher budget allocations, which may necessitate a reduction of the budgets of other government functions. At the macro level, there is loss in economy-wide productivity due to increased absenteeism of sufferers and carers of sick people, increased mortality from AIDS leads to a reduction in total labour force supply and a change in the skill composition of the labour force if AIDS affects one category of labour skill relatively more. Additionally, aggregate savings may decline as a result of households resorting to assets and savings for immediate health expenditures, and the reduced capacity to earn income.

Three types of macro models have been employed to evaluate the economic impact of HIV/AIDS. Macro-econometric models have been employed to estimate the association of HIV/AIDS economic growth with contrasting results (Bloom & Mahal, 1997; Bonnel, 2000; McDonald & Roberts, 2006) The macro-econometric models employed in these studies are essentially of a partial equilibrium nature incapable of capturing the back and forth a linkage of the mechanisms through which HIV impacts the economy. For instance, they cannot reflect the economy-wide wage differentials arising from the skill-biased effect of HIV/AIDS or the shift in resources between the tradable and non-tradable sectors, through the exchange rate movements, which might occur as more external resources for HIV interventions enter the economy. Macro-simulation models designed around the one-sector neoclassical growth model have also been applied mainly in African countries but have only been able to estimate the HIV/AIDS impacts at an aggregate level (Anyanwu, Siliadin, & Okonkwo, 2013; Cuddington, 1993; Lule & Haacker, 2012; MacFarlan & Sgherri, 2001; Robalino, Voetberg, & Picazo, 2002). These single-sector-design models are incapable of showing the differential impact of HIV on various sectors, cannot capture the compensating effect of other sectors and could potentially overestimate the loss in aggregate output by not accounting for the shift in resources and output between sectors.

Computable general equilibrium (CGE) models have been used to overcome the shortcomings of the partial equilibrium and aggregate level models since they enable sectors to be disaggregated to the desired level and are capable of capturing the forward and backward linkages between different

economic agents and sectors in the economy (Arndt & Lewis, 2000, 2001; Dixon, McDonald, & Roberts, 2004; Jefferis & Matovu, 2008; Kambou, Devarajan, & Over, 1992; Ojha & Pradhan, 2006; Thurlow, 2007; Thurlow, Gow, & George, 2009). CGE models specify equations that are capable of capturing the price-triggered substitution mechanisms during production, consumption and distribution of output, both within and between sectors. Additionally, CGE modelling is capable of analysing several policy shocks simultaneously to capture their combined effect as well as investigate effects of policy changes from internal or external shocks on macroeconomic variables.

The early studies using CGE modelling technique to evaluate the economy-wide impact of HIV/AIDS have concentrated on articulating the adverse effects of a decline in both quantity and quality of human capital through the main channels of population, labour and labour productivity growth. Responding to the long-term expenditure liability for HIV will have implications for the wider economy and requires a macro analysis in a general equilibrium set up which has not been undertaken to date. This paper addresses the gap by incorporating updating equations that capture the cost impact channels of funding HIV investments given the long term debt liability feature of funding HIV responses.

The purpose of this paper is to predict the economic impact of HIV and identify a sustainable funding model for HIV, taking Uganda as a case study for analysis. The paper assesses the long-term economic impact of domestic and external sources of financing HIV responses, using a dynamic CGE model. Uganda is purposefully selected as a case study to reflect a country with high prevalence rates of HIV and currently resource-constrained. The paper analyses the impact on government consumption and investment, government domestic and foreign debt, economy-wide wages and rents, and overall GDP growth. The main contribution of this research is the demonstration of Uganda's potential to raise tax revenue for funding HIV responses in the medium to long term and the benefits of doing so. The rest of this paper is structured as follows. Section 2 presents stylized facts on HIV in Uganda. The methodology for assessing HIV and funding sources in Section 3 describes the CGE model and its application to Uganda, and the design of simulation scenarios. Section 4 presents and discusses the simulation results while Section 5 explores new and innovative sources of funding HIV in Africa. Section 6 concludes the paper with policy implications.

2 HIV/AIDS in Uganda

Uganda has the highest adult prevalence rate of HIV in the East African region. By the end of 2013, the HIV prevalence for ages 15-49 years was 7.3% compared to 6% in Kenya, 5% in Tanzania, 2.9% in Rwanda and 1.3% in Burundi (World Health Organisation, 2014). Although the national response to HIV/AIDS dramatically reduced prevalence rates from 18.8% in 1992 to 6.4% in 2005, it rose again to 7.3% in 2013 and the epidemic has consistently affected women disproportionately compared to men (Uganda AIDS Commission, 2014). At the policy level, the National AIDS Policy 2010, the revised National Strategic Plan (NSP) for HIV & AIDS 2011 – 2015 and a rolling two-year National Priority Action Plan (NPAP) were developed to consolidate efforts to combat the epidemic but implementation of the envisaged strategies is hampered by lack of funding. For instance, the NPAP 2012/13 resource estimates for HIV interventions indicated a 41% gap in resources in flows and consequently only 69.4% of all ART-eligible PLHV were on treatment by September 2013 while planned activities in prevention, social support and health system strengthening also experienced a decline in funding (Uganda AIDS Commission, 2011)¹. Table 1 shows the resource needs and the funding gap for HIV responses in Uganda for 2011/12 – 2014/15.

Table 1 Uganda's HIV Financing gap under the NSP full funding scenario (US \$ Millions)

NSP estimates (full funding)	2011/12	2012/13	2013/14	2014/15	Totals
Total estimates	585.4	756.3	933.2	1136.5	3411.4
Government of Uganda	42.0	42.0	42.0	42.0	168.0
Others (external resources)	376.1	412.9	397.5	409.5	1596.1
Total Projected inflows	418.1	454.9	439.5	451.5	1764.1
Funding gap	167.3	301.4	493.7	685.0	1647.3
Funding gap (% of total estimate)	28.6	39.9	52.9	60.3	48.3

Source: Uganda AIDS Commission - National Strategic Plan for HIV (NSP) 2011/12 – 2014/15

Despite the large external funding the government has always fallen short of its target. It is estimated that commitment to higher than current levels of treatment and care for PLHIV would raise Uganda's financial liabilities to 59% of GDP and Uganda can only afford 46.7% of the total aggregated cost of ART, estimated at 21.1% of GDP for the period 2015 – 2050² (Atun et al., 2015; Collier et al., 2015). Moreover, a multi-country study that measured HIV spending against total health sector spending indicated that Uganda was spending about 50% of its health budget on HIV and there was no room for reprioritizing HIV in the health sector budget (Amico, Aran, & Avila, 2010; Remme et al., 2015). The government created the National AIDS Trust Fund proposing to raise money from levies and direct taxes as a response to the HIV funding challenge. Given the need for domestic resource mobilisation we are motivated to model the economy-wide impact of direct tax revenue for HIV responses.

3 Methodology for impact of HIV financing sources

3.1 Model description and HIV/AIDS impact channels

The CGE model is a set of simultaneous equations specifying the behaviour of different actors in the economy. We use a recursive dynamic model in order to capture the lagged effects of HIV/AIDS related health effects and the HIV intervention investments over time. This model is an adaption of the “core” version of the Maquette for MDG Simulations (MAMS) model developed by the World Bank group and documented in (Lofgren, Cicowiez, & Diaz-Bonilla, 2013). Technically the model is comprised of a static (within-period) equilibrium solution where producers maximise profit and consumers maximise utility in a given set of institutional constraints, and a dynamic (between-period) equilibrium solution. For the dynamic component, exogenous variables are updated to reflect changes in HIV/AIDS induced population and labour supply growth rates, capital accumulation and total factor productivity growth changes. Additionally, the HIV related government expenditure patterns and sources of funding are updated over the model period. The dynamic module captures the tracking of assets and liabilities of the households and the government, a feature that makes it suitable

to predict the impact of HIV intervention cost on debt sustainability. In principle, the within-period model solution for period t forms the basis for the next model run for period $t + 1$, the solution to which forms the basis for model run $t + 2$, etc., to form a recursive dynamic. The model equations are included in the supplementary appendix A1.

Production by the various sectors in the economy is represented by activities, where each activity produces a “commodity” (good or service). Producers are assumed to maximise profit in perfectly competitive markets and the production is assumed to exhibit constant returns to scale. Households receive factor income redistributed according to the value shares, given the factor endowment shares for each household. In addition, households earn income from net interest (the difference between net interest earnings from loans to government and net interest payments to the rest of the world), and receive transfers from other households, the government and the rest of the world. Both domestic and international remittances are a significant source of household income in Uganda. Domestic remittances are common between migrant household members in urban areas who send money to their rural household members. Personal remittances received in Uganda rose from 4.1% of GDP in 2010 to 4.4% in 2011 before declining to 3.8% in 2013 (World Bank, 2014)³. Households use their income to pay direct taxes to government, for commodity consumption (disposable income after tax), transfers to other households and the remainder is saved according to each household’s marginal propensity to save. The government current revenue is earned from direct taxation of factors of production, indirect taxation from domestic production and commodity outputs and import tariffs, and transfers from domestic institutions and the rest of the world. The government current revenue is used to finance (re)current expenditure which includes commodity consumption (government services such as provision of healthcare), transfers to households and the rest of the world, and interest payments on domestic and foreign debt.

Labour is assumed to be fully employed and mobile across sectors implying that workers who are laid-off by contracting sectors are able to find employment in expanding sectors so that the full employment condition is maintained. In reality the existence of a large informal sector occupies the unemployed. Equilibrium is obtained through flexible wages which adjust to assure that the sum of

labour demands from all sectors equates the quantity supplied. Land and capital are fully employed and immobile across sectors, earning a sector-specific wage that is variable.

The government and private investment, and the sources of financing the investments, are determined. On the supply side, domestic savings by households and government are transformed into different types of investments while foreign savings are transmitted to the domestic economy through transfers from the rest of the world and foreign direct investments. The government fixed investment value is derived from the government spending on capital goods. On the demand side, investment in different capital stocks is determined differently for non-government institutions and for the government.

For households, investment in different capital stocks is determined by total fixed investment values, the prices of capital goods, and the exogenous shares of different capital stocks. The government investment demand for capital stock is determined by the difference between the expected capital demand in the next period and the capital stock that would remain if no investments were made. The saving-investment balance focuses on the non-government component of savings and investment and the closure rule assumes an investment driven economy⁴. The balance-of-payment closure specifies a flexible exchange rate to clear the current account balance which is a plausible assumption for Uganda because the country's current exchange rate regime is flexible.

The model is calibrated from the Uganda social accounting matrix (SAM). A SAM is a comprehensive, economy-wide data framework representing the economy by capturing the financial value of transactions and transfers between all economic agents in the system, for a given period of time, usually a year. It is a square matrix with each account represented by a row (income) and a column (expenditure) i.e. the double entry system of accounting. We use the SAM for MAMS dataset for Uganda taking 2009/2010 as the base year⁵. The structure of a SAM for MAMS is included in the supplementary appendix A2.

3.2 The dynamic baseline scenario

The baseline simulation acts as a benchmark against which the impacts of healthcare financing reform policies are measured. It serves to portray how the economy would have performed

from 2009 to 2040 in the absence of additional effects accruing from HIV/AIDS and the associated healthcare costs and financing policies. The current HIV responses are assumed to prevail throughout. The baseline scenario assumes the status quo continues for internal and external factors, and policies that underpin the economy's rate of growth remain as portrayed in the 2010 social accounting matrix – the benchmark data set. The model is calibrated with a total factor productivity growth rate to generate an annual growth rate for real GDP to follow the historical path averaging 6%, a trend projected to continue as per the forecasts from the World Economic Outlook of the IMF. The government spending rule governing expenditure in the baseline scenario sets the government consumption demand (service provision) to grow as a fixed share of GDP and the evolution path is influenced by the initial consumption share in GDP. Government receipt items (direct taxes, indirect taxes and tariffs, transfers to government from rest-of-world, transfers from domestic non-government institutions, and government domestic borrowing) are modelled as a fixed share of GDP and the initial year shares in GDP determine the evolution path to 2040. Receipts from foreign borrowing are variable and adjust accordingly to balance the government budget. The baseline scenario population and labour force growth rate is 3% per annum according to the UN demographic model for Uganda. The current HIV prevalence rate at 7.4% prevails for the baseline scenario.

3.3 Impact channels for HIV financing sources

The impact is captured in two sets of simulations namely: the labour force growth scenarios and the source of funding HIV interventions scenarios. The first set of simulations captures household population growth and labour supply dynamics of HIV/AIDS. Every household group is endowed with a fixed share of every labour type in the economy. Thus, the population of each household in any year is determined by the household's population in the preceding year, the growth factor of its labour force and a population scaling factor. Two cases are modelled under this assumption.

Scenario 1: Constrained government funding (AIDS without intervention): This case is a hypothetical scenario which assumes that government does not make significant improvements towards treatment and prevention strategies for HIV/AIDS so that challenges reported in the 2013

HIV country progress report prevail throughout. This scenario relates to a situation where the baseline HIV prevalence rate at 7% prevails throughout while access to ART remains at levels reported at the end of 2013. Similarly, the funding challenges reported in 2013 continue such that minimal proactive steps are taken towards scaling up prevention strategies. This level of HIV responses as described here generates two shocks.

First, is the impact on supply of labour whereby the overall size of the labour force declines while the age structure changes⁶. We anticipate a decline in labour force growth as more people fall sick from AIDS, some of whom die while others are unable to work effectively. The assumption of a declining labour force growth rate is based on early studies in Sub-Saharan Africa showing the association of HIV/AIDS and mortality rates among the working population (Bos & Bulatao, 1992; Bulatao, 1990; Urassa et al., 2001). For example, in Tanzania mortality rates among HIV-infected adults were 15 times higher when compared with HIV-negative adults, HIV/AIDS was associated with about half of all deaths of people aged 15 – 44 years, the size of the working-age population (15-60 years) would be 20% smaller with HIV/AIDS than without. In Uganda, an epidemiological model projected the population to be smaller by 10% in 2020 and 14.9% in 2050 with AIDS. Therefore, in scenario 1 we predict a decline in labour force growth in Uganda which is modelled as a gradual reduction from the 3% baseline growth rate. That is, the Uganda model is shocked with a 2% growth rate up to 2025 and thereafter a 1% growth rate per year up to 2040.

Second, demand for healthcare increases as HIV infected persons are treated through the existing healthcare system. The government faces increased healthcare spending because of higher health expenditure per infected person⁷. The HIV/AIDS impact on demand of healthcare services is taken simply as the share of patients with HIV-related illnesses in the healthcare system. It is assumed that all people living with HIV in Uganda will need some form of healthcare and consider the Ministry of Health Spectrum projected number of PLHIV and the HIV-related deaths, and the Ugandan ‘facilities’ projected annual cost per ART patient (excluding ARVs) - \$57, to project a proximate government HIV expenditure (IHME, 2014b; Uganda AIDS Commission, 2014). We postulated that government healthcare expenditure as proportion of GDP will increase by at least 4% per year. Thus, the Ugandan model is shocked with a 4% annual increase in the government health

spending as a share of GDP, attributed to the additional care costs of PLHIV in the health system. The government function spending allocation is similar to the baseline scenario assumptions. In Scenario 1 the fiscal balance assumption is similar to the baseline scenario where foreign borrowing adjusts to balance the government budget⁸.

Scenario 2: Constrained government funding (AIDS with intervention): In this case we assume that government undertakes targeted strategies towards treatment of PLHIV and prevention measures to reduce the prevalence rate. This scenario assumes government will reallocate resources to HIV responses such that the NSP objectives and targets are achieved⁹. With constrained government financing a reallocation of resources to investments in HIV responses would have an immediate effect of a reduction in resources available for other government functions. For modelling purposes the HIV investments are assumed to generate two shocks.

First, the interventions reduce transmission rates as well as HIV related mortality and morbidity so that life expectancy of PLHIV is increased and the labour participation rate of the infected and affected people increases. It is further assumed that the scaling up of HIV responses is gradual and the health effects are lagged and these are reflected in the model by considering gradual increases in labour force productivity and supply in the economy. Labour force growth rate is assumed to increase by an additional 1% from the 3% baseline rate so that the model is shocked with a 4% annual growth up to 2020. An additional labour force growth rate of 2% (from the baseline rate) is assumed to occur beyond 2020 due to higher coverage rate of HIV responses and the health effects paying off. Thus, the model is shocked with 5% annual growth for 2021–2030. Finally, the full programme of HIV responses and commensurate health effects are assumed to occur and prevail throughout. Consequently an additional 3% labour force growth rate (from the baseline rate) is assumed so that the model is shocked with a 6% annual growth for 2031–2040.

Second, the HIV interventions envisaged in this model assume comprehensive treatments for PLHIV as well as prevention measures, thus generating additional costs over and above the treatment costs assumed in Scenario 1. The model is shocked with a 10% annual increase in government health spending as a share of GDP using guidance from reports on the required HIV funding increase and the

cost of comprehensive HIV treatment in Uganda (Menzies et al., 2011; Uganda AIDS Commission, 2014). Also, the growth rate in spending is selected so that by 2040 the country should have achieved a level of health spending share in GDP at or above the recommended minimum 5% of GDP for universal health coverage in developing countries (CMH, 2001; McIntyre & Meheus, 2014). It is further assumed that 50% of the health budget goes to fund HIV responses based on the findings in Amico et al (2010). The government spending allocation in this scenario is also similar to the assumptions in the baseline scenario and foreign borrowing adjusts to balance the budget.

The second set of simulations captures the HIV impact channels reflecting the source of funding healthcare costs generated by HIV interventions. For both Scenario 1 and Scenario 2 above, the government is assumed to be spending according to its budget with government receipts are assumed to grow at a fixed rate determined by the GDP growth rate and the budget balanced by foreign borrowing, as assumed in the baseline simulation. However, in the following two cases, we specify the source of additional funding for healthcare when the share of health spending is increased.

Scenario 3: Increasing Foreign aid funding for HIV: Here we consider an increase in foreign transfers channelled to the financing of government health for HIV. The target is to increase government receipts while expanding government health spending. We assume that all foreign aid for health is channelled through the government budget so that the HIV component of the aid-money is spent according to priorities laid down in the NSP for HIV/AIDS and the Health Sector Strategic Plan. We shock the model with a 20% annual increase in foreign transfers to government from the rest of world specifically for the government health commodity. At the same time, the selected government spending rule imposes flexibility so that health spending is the budget balancing item. This model operation signifies an increase in foreign grants as share of GDP channelled to government health spending. The annual increase in foreign aid for HIV modelled in this study is in line with the suggestion by Atun et al (2015) recommending continued and where possible, increasing development-aid for health (HIV funding) to poor Sub-Saharan countries like Uganda.

Scenario 4: Increasing Tax revenues: In this case, we consider an increase in domestic direct tax revenue as a source of additional health spending for HIV. The model manipulation is similar to Scenario 3 except that the government receipts are increased by direct tax revenue. Therefore, the model is shocked with a 10% annual increase in direct tax revenue as share of GDP and the adjustment in government health spending clears the government budget. The 10% annual growth rate in direct tax to GDP share is selected on the basis that effective tax rates will adjust so that by 2040 the government has sufficient revenue to achieve the minimum targeted 15% contribution towards HIV/AIDS resource requirements (Uganda AIDS Commission, 2012).

4. Results and discussion

Model simulations were performed and results presented as comparative growth rates for the period 2009 – 2040. The impact of HIV/AIDS with and without intervention and the different sources of funding the interventions are contrasted with the dynamic baseline growth path. Throughout the analysis HIV/AIDS intervention refers to both treatment and prevention strategies. Results are analysed for the impact on government consumption and investment expenditure, government domestic and foreign debt, factor prices and GDP growth.

4.1 Impact on government consumption and investment expenditure

Table 2 shows the government consumption and investment expenditure share in GDP by 2040 across scenarios.

Table 2 Government budget as a percentage of GDP: 2009 and 2040 by simulation

Indicator	2009	<div> Constrained funding AIDS without intervention (Scenario 1) Constrained funding AIDS with intervention (Scenario 2) Foreign aid and AIDS with intervention (Scenario 3) Taxation and AIDS with intervention (Scenario 4) </div>				
		Baseline				
Income	Capital (households)	2.31	2.31	2.31	2.31	2.31
	Capital (Rest of World)	2.49	0.35	0.14	4.35	0.35
	Factor Capital (private)	0.04	0.001	0.001	0.001	0.001
	Households	0.35	0.35	0.35	0.35	0.35
	Rest of world	2.66	2.66	2.66	2.66	8.86
	Tax (direct)	4.01	4.01	4.01	4.01	10.02
	Tax (import)	5.92	5.92	5.92	5.92	5.92
	Tax (VAT)	2.27	2.27	2.27	2.27	2.27
Total		20.04	17.86	17.65	21.86	24.07
Spending	<u>Government Services</u>					
	Education (primary)	1.68	1.68	1.68	1.68	1.68
	Education (secondary)	0.34	0.34	0.34	0.34	0.34
	Education (tertiary)	0.48	0.48	0.48	0.48	0.48
	Health	0.95	0.95	1.21	3.04	6.94
	Other infrastructure	0.03	0.04	0.06	0.03	0.05
	Public administration	6.24	6.24	6.24	6.24	6.24
	Water and sanitation	0.01	0.01	0.01	0.01	0.01
	<u>Others</u>					
	Households	3.68	3.68	3.68	3.68	3.68
	Interest (domestic)	0.95	0.98	1.14	0.88	0.96
	Interest (foreign)	0.17	0.16	0.09	0.51	0.15
	<u>Government Investment</u>					
	Education (primary)	0.31	0.08	0.03	0.16	0.05
	Education (secondary)	0.08	0.02	0.01	0.04	0.01
	Education (tertiary)	0.10	0.02	0.01	0.05	0.02
	Health	0.32	0.06	0.05	0.90	0.59
	Other infrastructure	2.19	2.19	2.19	2.19	2.19
	Public administration	2.21	0.82	0.38	1.45	0.58
	Water and sanitation	0.31	0.11	0.07	0.18	0.09
	Rest of World	0.01	0.01	0.01	0.01	0.01
	Total	20.04	17.86	17.65	21.86	24.07

Note: Interest (domestic) = net domestic interest payments to domestic private sector, interest (foreign) = net foreign interest payments to Rest of World

With constrained funding, the government is compelled to reallocate more resources for recurrent health expenditure as the demand for healthcare increases with HIV infected persons seeking treatment in the existing general healthcare system (Scenario 1) or as it expands investments

in HIV responses (Scenario 2). At the same time government reduces investment expenditure in both health and other government functions. A persistent constrained government funding expenditure pattern that reduces capital investment for government functions could be precarious in the long-term as it may hamper continued provision of quality government services overall. Hence the more need to mobilise additional funding for HIV responses.

4.2 Impact on government domestic and foreign debt

The impact on government debt varies according to the source of additional HIV health funding. Table 3 shows the government debt as a share in nominal GDP by 2040. When government funding is constrained and at the same time it is faced with escalating healthcare costs arising from palliative care for PLHIV (Scenario 1) or investment in HIV responses (Scenario 2), government adjusts its spending pattern by reallocating the available resources and borrowing from foreign sources only when there is a shortfall in the budget.

Table 3 Government debt as share of nominal GDP (%)

		2040				
Indicator	2009	Constrained funding AIDS without intervention (Scenario 1)		Constrained funding AIDS with intervention (Scenario 2)		Foreign aid and AIDS with intervention (Scenario 3)
		Baseline				Taxation and AIDS with intervention (Scenario 4)
Foreign government debt	15.88	14.89	8.40	46.31	13.46	14.01
Foreign private debt	0.03	16.45	17.61	15.24	15.46	15.85
Domestic government debt	17.69	18.34	21.20	16.46	18.02	18.02

The high foreign debt share in GDP under the constrained funding scenarios is because foreign borrowing is the balancing item for the government account closure rule adopted where government receipts from foreign borrowing are variable and adjust accordingly to balance the

government budget. Although the foreign borrowing, (over and above the baseline levels), is not earmarked for HIV interventions, it is clear that additional foreign borrowing to balance the budget is triggered by the need for increased government health expenditure. An estimate by Atun et al (2015) indicates that new funding obligations for HIV treatment in Uganda would raise the debt to GDP ratio to 59% 2050 (Atun et al., 2015). The result from our modelling exercise shows that additional funding for HIV from either foreign aid or domestic taxation mitigates the escalation of the debt to GDP ratio. This is made possible by lower borrowing rates hence lower interest payments. For instance, it is predicted that government spending on foreign interest payment would be 0.15% of GDP under the increased funding options (aid or taxation) compared to 0.50% under the constrained funding. Moreover, the proposed investment in HIV treatment and prevention generate higher growth rates in labour force supply and productivity in the economy as well as a healthy population who are also likely to be prolific consumers leading to faster growth in GDP which further serves to maintain lower interest rates.

4.3 Impact on wages and rents

For purposes of this modelling exercise, labour classification is based on completed years-of-schooling for the individual. Labour is classified as unskilled for working people who completed less than secondary education, semi-skilled for working people who completed secondary education and skilled for working people who completed tertiary education. Table 4 shows the annual growth in wages and rents from 2009 to 2040. The rise in wages under the constrained funding for AIDS without intervention (Scenario 1) is consistent with the assumption that AIDS prevalence without targeted treatment and prevention strategies would lead to a decline in the labour force growth rate due to mortality, morbidity and labourers caring for the sick. As the growth rate in labour force declines, demand rate for labour surpasses the supply rate and drives up wages in the labour market.

On the other hand, the relative decline in wages under the constrained funding for AIDS with intervention scenario is due to the abundance of labour from the model assumption that AIDS prevalence with targeted treatment and prevention strategies would improve population health which

will result in increased labour participation rates and labour force growth rates. Consequently an abundance of labour in the economy drives down wages relative to the baseline.

Table 4 Annual growth in real average wages and rents: 2009 - 2040 (%) - deviation from the baseline

	Constrained			
	funding AIDS without intervention (Scenario 1)	Constrained funding AIDS with intervention (Scenario 2)	Foreign aid and AIDS with intervention (Scenario 3)	Taxation and AIDS with intervention (Scenario 4)
Factors of production				
Capital - private	-0.88	0.41	-0.65	-0.32
Labour – unskilled	1.37	-1.23	0.25	0.08
Labour – semi-skilled	1.52	-1.20	0.70	0.48
Labour – skilled	1.64	-1.04	1.30	1.08
Land	-1.45	1.20	0.38	-0.13

The adjustment in skilled labour wages is worth noting in relation to the dynamics of expanding a skill oriented service (HIV- health) sector. For the constrained funding for AIDS without intervention the rise in wages is highest for skilled labour due to the “factor bias effect” of expanding a skill-intensive health sector in production equilibrium amidst a declining labour force growth due to AIDS. The increased demand for HIV healthcare generates increased demand for healthcare production of which skilled labour constitutes a relatively large proportion of the input requirements. The increase in demand drives up wages for skilled labour which is in short supply in Uganda. Similarly, under the constrained funding for AIDS with intervention the decline in wage rates for skilled labour is relatively smaller compared to other labour categories because skilled labour may still be scarce in the short to medium term since it takes relatively long time to train and qualify. For example, it takes an average of seven years for general practise physicians to qualify in Uganda. Overall, there is never an abundance of skilled workers in Uganda so that their wages are sticky downwards. When the impact on wages is compared among funding sources for AIDS with intervention, the foreign aid scenario predicts higher growth rates when compared to the tax scenario. This happens because aid money is an additional resource in the economy in contrast to the taxation scenario which is simply a reallocation of existing resources from one agent to the other. As an

additional resource, aid money creates immediate extra demand for inputs with which to combine and produce the desired output. And if it is spent in a labour intensive HIV healthcare sector it drives up demand and consequently wages for labour especially skilled labour.

4.4 Impact on GDP growth rates

Figure 1 illustrates the trend in annual GDP growth for different scenarios. The constrained funding for AIDS without intervention predicts lower GDP growth rates relative to the baseline because of declining growth in labour force supply and productivity. On the other hand, constrained funding for AIDS with intervention is predicted to generate higher GDP growth rates compared to the baseline but this is achieved at the cost of an escalating government foreign debt 46.3% as share of GDP (see Table 3). A similar rate in GDP growth can be achieved with direct taxation as the source for additional funding for HIV responses which also keeps the government foreign debt at 14% share in GDP.

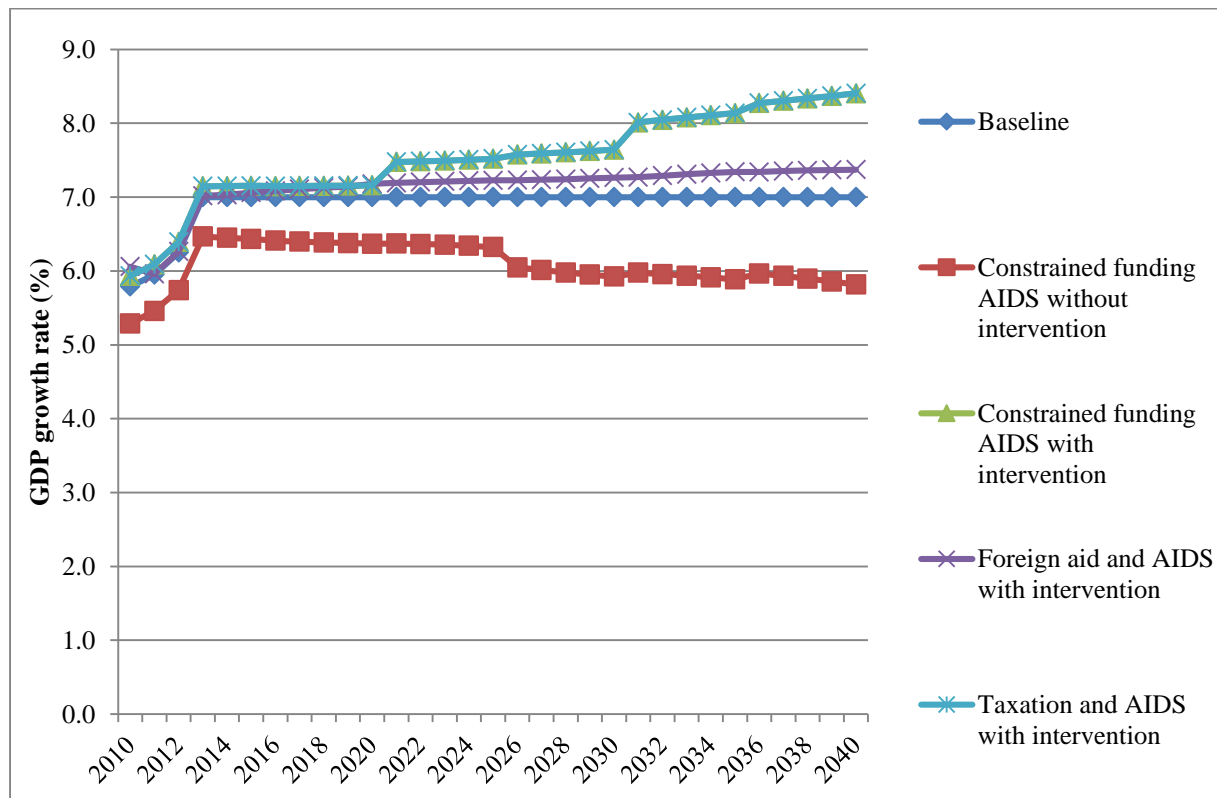


Figure 1 Annual growth in GDP 2010 - 2040

It is imperative to consider the underlying sector growth rates so as to fully comprehend the basis of the observed trend in GDP growth. Table 5 shows the percentage deviation from the baseline for annual growth rates in GDP at factor cost under different scenarios. The aid-funded scenario stimulates higher growth rates in ‘the services sector’ compared to the tax-funded scenario. This is because the cost of production in the services sector is lower under the aid scenario compared to the taxation scenario since private capital rents are relatively lower under the aid-funded scenario so that the services sector is able to substitute the relatively more expensive skilled labour with the relatively cheaper private capital to increase its production output. Private capital rents are predicted to be lower under the aid scenario when compared to the tax scenario because taxation reduces the income available to individuals who may in turn save less. Lower savings may imply lower private capital for investment and hence relatively higher price for private capital. This finding suggests a crowding-out effect when private investment is displaced by increased government spending (for HIV health) funded through increased tax revenues. However, if the tax revenue is used for HIV investments which also improve population health, the combined benefits are greater for the whole economy as seen in the predicted GDP growth under taxation (see Figure 1).

Table 5 Growth in GDP at factor cost: 2009-2040 (%), deviation from the baseline

Activity/Sector	Constrained funding AIDS		Foreign aid and Taxation and AIDS	
	without intervention	Constrained AIDS with intervention	AIDS with intervention	with intervention
	(Scenario 1)	(Scenario 2)	(Scenario 3)	(Scenario 4)
Agriculture	-0.71	0.55	0.08	-0.03
Industry	-0.87	0.30	-0.45	0.16
Industry-mining	-1.22	1.01	0.14	0.00
Industry-manufacturing	-0.86	0.29	-0.46	0.16
Services	-0.82	0.72	0.40	0.17
Services non-government	-0.77	0.64	0.40	0.15
Services government	-1.83	1.71	0.43	0.45

The sectoral impact results also highlight the importance of sectoral disaggregation in evaluating the impact of fiscal space for HIV because sectoral difference can be obscured by

aggregating the impact. Whereas at the aggregate level the growth in GDP is about the same for both aid-funded and tax-funded HIV interventions, there are differences at sector level. The industry value-added is predicted to decline when HIV intervention is funded through foreign-aid, specifically attributed to a predicted fall in value-added in manufacturing. While foreign aid is earmarked for expansion of HIV healthcare services, Uganda has limited manufacturing capacity to supply the crucial inputs to the expanding health sector such as medicines and hence does not experience a commensurate expansion¹⁰. Moreover, wages rates are relatively higher under the aid scenario compared to the taxation scenario implying that the aid scenario creates a competition for labour particularly skilled labour which may raise the cost of production in the skill intensive industrial manufacturing sector and hence the contraction in this sector relative to the baseline. However, promoting local industrial production of antiretroviral medicines (ARVs) for HIV in Uganda could boost the industrial value-added when foreign aid for HIV increases service delivery in the health sector.

On the other hand, when HIV interventions are funded through taxation growth in agricultural value-added is predicted to decline when compared to the baseline. This is because agriculture in Uganda is largely by small holder farmers whose income is reduced by taxation and therefore less ability to invest in activities such as opening up new fields for cultivation or value addition. However, the model predicts falling prices for land (see Table 4) which could be an opportunity to develop large commercial farming as a government policy for expanding agriculture GDP under the taxation scenario.

5 Innovative Financing sources for HIV

Selected innovative financing instruments have been used successfully to raise additional funding for HIV in Africa including Debt Buy-down in Botswana, Debt2Health debt swap agreement and a tax levy for the AIDS Trust Fund in Zimbabwe (Atun, Silva, Ncube, & Vassall, 2016). Approaches such as reprioritising the health budget, efficiency savings in the health sector and

national health insurance schemes could also be undertaken by growing economies to create fiscal space for HIV (AfDB, OECD, & UNDP, 2015)¹¹.

New sources and innovative mechanisms for financing HIV investments that could be adopted in African countries include Remittances and Diaspora bonds, Social and Development Impact Bonds, Sovereign Wealth Funds, and Guarantees for borrowing. Some of these instruments have been used to mobilise investment financing for causes other than health but also have potential for use in mobilising resources for HIV. Given Africa's comparative advantage in natural resources, we propose a natural resource levy such as an oil tax on exports, as a viable source of funds for a Development Fund component of Sovereign Wealth Funds (SWFs) (Truman, 2010)¹². A proportion of the Development Fund could be ring fenced to cater for HIV investments, for instance, in treatment and health system strengthening given that investment in human capital in the form of health is an investment for the future generation.

The Social Impact bonds (SIBs) emphasize payment for results and could be implemented in HIV prevention to reduce HIV prevalence rates and social support and protection to improve the level of access of services for PLHIV. Similarly, Development Impact Bonds (DIBs), where the payer for an outcome is an international donor or development partner, could be undertaken for scaling up prevention services such as circumcision drawing lessons from its implementation in the education sector in India (Stagars, 2015).

Remittances could be mobilised through an issue of a diaspora bond for a specific cause such as HIV health investments. Diaspora bonds provide a cheap and stable source of external finance and have been successfully implemented by India and Israel to raise foreign capital (Ketkar & Ratha, 2009). Remittances are a key source of external resource flows for Africa and far exceed official development aid (AfDB et al., 2015). The bond can be set up to raise revenue on a continuous basis, for example to fund the continuous care and treatment of PLHIV by improving their quality of life and mitigating health effects of HIV/AIDS, or it could be an opportunistic issuance (on-demand basis) for example to fund reduction in HIV prevalence through a country-wide male circumcision campaign.

Risk guarantees which have been traditionally used to facilitate mobilisation of large private investment financing could be extended to HIV investments because there are economy-wide benefits of investing in HIV treatment and prevention as has been demonstrated in this paper. Although risk guarantees have mainly been implemented in the power sector in Sub-Saharan Africa such as Zito power project in Cote d'Ivoire and Bujagali hydropower project in Uganda, there is potential to extend guarantees beyond the large infrastructure projects to small and medium enterprises (Ratha, Mohapatra, & Plaza, 2009).

6. Conclusion and Policy implications

HIV/AIDS remains a challenge in as far as it affects the most productive segments of society. The problem is even larger for resource-poor countries of Sub-Saharan Africa despite scientific advances in treatment of the epidemic. Poor countries simply cannot afford the long-term liability of ARTs and hence a call for the moral duty to rescue those infected with HIV in poor Sub-Saharan countries. The devastating effects of HIV on an economy have been demonstrated with an application to Uganda where prevalence of HIV with constrained government funding may be detrimental as it slows down the rate of economic growth. On the other hand, this modelling exercise suggests there are economic benefits of increasing government funding for HIV responses.

This research provides evidence for the case for donors and policy-makers to frontload investment in HIV treatment and prevention, by showing the significant economic benefits from doing so. It has been demonstrated that foreign aid could be a valid source of funding HIV in the short to medium term, for LICs like Uganda. Given the scarcity of resources and the benefits of increasing spending on effective prevention and on treatment as soon as possible, it is desirable that Development Aid for Health be increased in order to limit the future HIV/AIDS obligations and facilitate the ability of governments to meet these. It should be noted that we have assumed that all foreign aid for health is channelled through the government budget so that aid-money is spent according to priorities as laid down in the National Strategic Plan for HIV/AIDS and the Health

Sector Strategic Plan. However, it is also acknowledged that some donors still prefer to channel aid to specific projects and that the sustainability of aid-inflows cannot be guaranteed.

The paper has also shown that LICs like Uganda may possess the potential for domestic resource mobilisation through direct taxation to fund HIV programmes in the long term. It is therefore imperative that policy makers – in Uganda and other LICs grappling with similar challenges – devise means to increase domestic revenue for which the most obvious source would appear to be direct taxes. We recognise that raising taxes is a sensitive political issue. However, taxation that is anchored to quality health service delivery can be attractive to the citizenry. It is therefore crucial that while taxes rates are increased, the quality and quantity of health services should be stepped up.

For future research, we propose to analyse the economic impact of innovative sources of funding HIV responses, including Remittances and Diaspora Bonds, Social Impact Bonds and Development Impact Bonds, and Sovereign Wealth Funds. It is also plausible to investigate the impact of funding sources for HIV on poverty rates in Uganda as well as apply the model to different countries with different resource constraints.

NOTES

1. The treatment achievement is based on the 2010 WHO ART guidelines. The achievement rate drops to 40% when the 2013 WHO ART eligibility guidelines are used.
2. Financial liability is calculated as the sum of debt levels and the present-value of the stock of future HIV liabilities. In that study the aggregated ART cost share in GDP estimate is scaled up for HIV incidence and uses the 2010 WHO eligibility for ART at the 350 CD4 cells per mm³ thresholds. This means the cost could be much higher when the 2013 WHO guideline for ART threshold (500 CD4 cells per mm³) is used.
3. The World Bank defines personal remittances to include personal transfers consisting of all current transfers in cash or in kind made or received by resident households to or from nonresident households and compensation of employees consisting all the income of border, seasonal, and other

short-term workers who are employed in an economy where they are not resident and of residents employed by nonresident entities.

4. Government saving and investment are determined differently. The government investment expenditure is determined by the demand for capital by the different government services while the government savings depends on the closure rule adopted for the government balance.

5. The SAM for Uganda MAMS was built by the Uganda Ministry of Finance under a UNDP, UN-DESA project: “Strengthening Macro-Micro Modelling Capacities to Assess Development Support Measures and Strategies in Uganda”, facilitated by Martin Cicowez and Marco Sanchez.

6. For example, it is assumed that constrained government funding for HIV may lead to increased HIV prevalence rates and AIDS mortality rates so that the share of the members of a cohort entering the labour market at a given time declines. As a result the average age of the workforce declines and consequently work experience falls as well as productivity in some sectors that require certain skills acquired on the job. A formal description of the association between HIV mortality rates and the average age of the work-force is established (Haacker, 2002).

7. In a study to determine the burden of HIV/AIDS to the healthcare system in South Africa, it was shown that HIV patients had higher utilisation rates of health services compared to other patient groups (Cleary, Boule, Castillo-Riquelme, & McIntyre, 2008). Early studies on the impact of HIV/AIDS on demand for health services and thus on the cost of service delivery indicators have shown an enormous burden exists in resource-poor settings (Haacker, 2001; Over, 2004; World Bank, 2001). For example, if 10% of all HIV positive people sought services of a physician, the ratio of HIV-positive patients to physicians would range from 17 (for South Africa to 250 (for Malawi)(Haacker, 2001). Similarly, the World Bank study in Botswana revealed that 60% of all hospital beds were being allocated to patients with HIV-related illness and if the trend in prevalence continued the number of beds required by HIV patients would exceed the total number of available beds in 2002 (World Bank, 2001). Typically the HIV epidemic leads to soaring costs to the health sector in resource constrained developing countries like Uganda (Over, 2004).

8. The rising demand for healthcare services by HIV-patients requires that government seeks to find additional resources to produce public healthcare and meet the increased demand for healthcare. In

this model set up, the government sources of revenue are fixed (except foreign borrowing). The government can choose to penalise other sectors by reducing their budgets and reallocating the resources to health or it can choose to borrow from foreign resources to balance the budget while maintaining the expenditure shares for other sectors. The assumption here is that the government balances the budget through foreign borrowing. Haacker (2015) cautions that foreign borrowing for funding HIV might be a plausible option only in specific circumstances such as to manage spikes in the cost of HIV interventions (Haacker, 2015). However, it would be worthwhile investigating the impact of foreign borrowing contrasted with domestic borrowing earmarked for HIV, a task to be explored in future.

9. The National Strategic Plan for HIV 2011/12 – 2014/15 proposals include: (i) to reduce HIV incidence by 30% by 2015 and (ii) to improve the quality of life of PLHIV by mitigating the health effects of HIV/AIDS by 2015 (Uganda AIDS Commission, 2012).

10. For instance, only 10% of medicines and pharmaceuticals are reportedly manufactured in Uganda (UNIDO, 2010).

11. Africa has posted impressive growth rates in GDP from just above 2% in the 1980s and 1990s to more than 5% between 2000 and 2014. Africa's turnaround in GDP growth rates in the 2000s was higher than general world growth, just above 4%, and higher than Latin America and the Caribbean, just above 3%.

12. The author provides a list of 83 generic SWFs of 54 countries, in Table 2.1, showing the date of its establishment, the principal source of funds, and its size. The data reveals that natural resources are the predominant principal source of funds.

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